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Volume I
Revision 0

Hanford Spent Nuclear Fuel Project Recommended Path Forward

Volume I: Recommended Path Forward

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Prepared for the U. S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company Richland, Washington
Hanford Operations and Engineering Contractor for the
U. S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

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1.0 EXECUTIVE SUMMARY

The Spent Nuclear Fuel Project (the Project), in conjunction with the U.S. Department of Energy-commissioned Independent Technical Assessment (ITA) team, has developed engineered alternatives for expedited removal of spent nuclear fuel, including sludge, from the K Basins at Hanford. These alternatives, along with a foreign processing alternative offered by British Nuclear Fuels Limited (BNFL), were extensively reviewed and evaluated. Based on these evaluations, a Westinghouse Hanford Company (WHC) Recommended Path Forward for K Basins spent nuclear fuel has been developed and is presented in Volume I of this document.

The recommendation constitutes an aggressive series of projects to construct and operate systems and facilities to safely retrieve, package, transport, process, and store K Basins fuel and sludge. The overall processing and storage scheme is based on the ITA team's proposed passivation and vault storage process. A dual purpose staging and vault storage facility provides an innovative feature which allows accelerated removal of fuel and sludge from the basins and minimizes programmatic risks beyond any of the originally proposed alternatives. The projects fit within a regulatory and National Environmental Policy Act (NEPA) overlay which mandates a two-phased approach to construction and operation of the needed facilities.

The two-phase strategy packages and moves K Basins fuel and sludge to a newly constructed Staging and Storage Facility by the year 2000 where it is staged for processing. When an adjoining facility is constructed, the fuel is cycled through a stabilization process and returned to the Staging and Storage Facility for dry interim (40-year) storage. The estimated total expenditure for this Recommended Path Forward, including necessary new construction, operations, and deactivation of Project facilities through 2012, is approximately $1,150 million (unescalated).

The Recommended Path Forward combines aspects of several of the originally developed alternatives, thus optimizing across the most compelling objectives and constraints. In general, the concept of vault storage of dried, passivated metal fuel (the ITA proposal) was used. However, temporary staging of wet packaged fuel and sludge prior to processing was added to improve the schedule for K Basins fuel and sludge removal. Using the dry storage vault facility for temporary fuel staging avoided the need to construct a separate basin to perform this function. While the recommendation proposes a Hanford Site strategy for processing and storing K Basins spent nuclear fuel, the BNFL foreign processing and other alternatives are retained as options in the second phase of the proposal, as consistent with policy and NEPA decisions beyond the purview of the Hanford Site.

Details of the evaluation results and engineering studies are presented in Volumes II and III.

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2.0 INTRODUCTION

The purpose of this document is to provide WHC's recommended path for resolving the safety and environmental concerns associated with the deteriorating fuel in K Basins and providing for the safe interim storage of this material pending establishment of a national spent nuclear fuel strategy and the criteria for its ultimate disposal. The recommendation culminates five months of engineering studies and evaluations focused on accelerated removal of fuel and sludge from the Hanford K Basins and its placement in a stable dry storage configuration until final disposition is achieved in the future.

To arrive at the recommendation, risk-based decision techniques were utilized in conjunction with a variety of technical and programmatic reviews that include senior experts from outside Hanford. Results from these reviews and analyses were used to formulate a technical and regulatory strategy which optimizes within the alternatives studied.

The recommendation proposes on-site stabilization and interim storage of the K Basins fuel. Foreign alternatives, such as the BNFL concept were considered and could be viable, but rest heavily on policy issues outside Hanford's purview. Information on the domestic activities required to support a foreign processing option including cost, schedule, regulatory issues, and potential vulnerabilities is provided for comparison with the recommended path.

Background

The Spent Nuclear Fuel Project was formed in early 1994 to manage Hanford's spent nuclear fuel and to address the urgent need to move the metal fuel from the present degraded storage conditions in K Basins to stabilized interim storage until final disposition is decided at the national level. About 80% of the U.S Department of Energy's (DOE) spent nuclear fuel inventory is located at the Hanford K Basins.

Although the basins originally served the K-Reactors, N Reactor fuel was accumulated from 1978 through 1987. Storage at K Basins was intended to be only as needed to sustain operation of N Reactor while PUREX was placed in standby for refurbishment and restart. Although PUREX did process much of the N Reactor fuel as planned, the decision in December 1992 to deactivate the PUREX facility left approximately 2,100 metric tonnes of N Reactor spent fuel in the K Basins with no means for near-term removal and processing. Fuel stored in the basins exists in a degraded state with further corrosion continuing unchecked. While fuel in the K-West Basin is contained in sealed canisters, the fuel in K-East Basin remains in open canisters allowing release of fission products to the basin water.

The November 1993 report of the DOE Spent Fuel Working Group (DOE 1993) listed K Basins among the few DOE spent nuclear fuel facilities given the highest priority to resolve environmental, health, and safety vulnerabilities. Review by the Defense Nuclear Facility Safety Board (DNFSB) resulted in a strong recommendation (DNFSB 1994) to remove fuel from the K Basins as soon as possible. Negotiations with signatories of the Hanford Federal Facility

Agreement and Consent Order defined a target milestone to achieve fuel removal by 2002.

Evaluation Process

The goals of this evaluation were to establish the basis for a high confidence path to: (1) expedited fuel and sludge removal from the K Basins, relieving safety and environmental concerns, and (2) safe, cost-effective, and environmentally sound interim storage of these materials pending establishment of the criteria for their ultimate disposition.

In developing a recommended path, WHC considered a broad range of alternatives including:

1. Containerization of the fuel and sludge in K-East Basin and storage of these materials in the K Basins until facilities are available for the transition to dry interim storage.

2. Removal of the fuel and sludge from both basins at the earliest possible date to a newly constructed temporary wet storage basin that meets modern safety and environmental requirements until facilities are available for the transition to dry interim storage.

3. Expedited transition directly to dry interim storage based on the process developed by the ITA team.

4. Processing the fuel overseas based on the concepts developed by BNFL and providing for retrieval and disposition of the sludge at Hanford.

5. Variations within and among the above alternatives.

The evaluation process included analysis of cost, schedule, regulatory and stakeholder drivers, and affected tribe values; independent assessments by outside experts and the use of decision analysis techniques to assure a comprehensive, balanced treatment of the various alternatives. An important aspect of this process was the identification of issues, their potential impacts, and how they might be mitigated. The decision evaluation included:

- Screening of alternatives against technical and safety requirements
- Programmatic risk assessment
- Health, safety and environmental risk assessment
- Multi-attribute decision analysis

A number of assumptions were made as bases for requirements and used as discriminators in evaluating the four alternatives. These assumptions were approved by DOE and are as follows:

1. Spent nuclear fuel is not waste.

2. Sludge is considered to be spent nuclear fuel.

3. The evaluation is limited to the current four alternatives.

4. The evaluation process ends with receipt and custodianship of K Basins fuel in dry interim storage.

5. The annual dry interim storage costs are the same for all alternatives.

6. Any new facilities will meet the intent of Nuclear Regulatory Commission (NRC) licensing requirements through equivalency.

7. Modifications to existing facilities will be in accordance with DOE Orders and requirements.

8. Forty-year dry interim storage will meet the intent of NRC licensing requirements.

9. Alternatives will not prejudice the DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement (Programmatic EIS).

10. Alternatives will accommodate disposition of K Basins water and debris. The waste from decontamination and decommissioning of any new or modified facilities other than dry interim storage will also be accommodated.

During the course of evaluation, alternatives were occasionally modified or adjusted to optimize their viability against the evaluation criteria, or to meet minimum technical and safety requirements. Further discussion of the evaluation process and results are presented in Section 3.9 and Volume II.

Scope of the Recommendation

The recommendation focuses on removal and interim storage of all fuel and sludge currently within the K Basins. The classification of sludge as fuel or non-fuel is a pending issue. If sludge is classified "non-fuel" it will likely be accumulated and removed for management outside the scope of this recommendation. If sludge (either bulk sludge in the basins and/or residual sludge remaining within the fuel canisters) is classified as fuel, it will follow the Recommended Path Forward. Although not discussed in detail the recommendation includes disposition of contaminated water and debris within the K Basins and prepares the basins for decommissioning. This recommendation does not address management of other spent nuclear fuel at the Hanford Site other than their consideration in the development of facility design requirements.

Basis for Recommendation

Review and evaluation of the proposed alternatives revealed several important issues which needed to be satisfied by the Recommended Path Forward. Although each alternative appeared to be technically viable, common issues of regulatory, sociological, and programmatic nature emerged as the primary barriers to an achievable strategy. The dominant issues and their impacts are as follows:

1. Urgent need to move fuel from the K Basins and away from the Columbia River

This issue stems from concerns voiced by the Hanford Advisory Board, affected Tribes, the DNFSB, and others. It also reflects Westinghouse's desire to lower safety and environmental risks within their operations as quickly as possible. In formulating the Recommended Path Forward, rapid removal of fuel and sludge from the K Basins was given high priority. The issue is the lack of an existing facility to receive the fuel and sludge. The Recommended Path Forward minimized the impact by expediting construction of a fuel Staging and Storage Facility, which is similar to well established technology available in the commercial nuclear industry.

2. The need to achieve stable, low-cost interim (40-year) storage for the K Basins fuel and sludge

The fuel will continue to corrode and degrade as long as it remains wet. Wet storage is also somewhat more costly to maintain than dry storage. Dry interim storage has thus become an important objective to the DOE Integrated Spent Nuclear Fuel Program. Achievement of dry storage at Hanford requires construction of both a dry storage vault and Stabilization Facility. Issues arise in developing the drying and passivation process selected for stabilization, and providing the technical basis for process licensing. These issues could extend schedules for startup of the Stabilization Facility and would lengthen storage time at the K Basins unless adequate new temporary storage is provided in advance of the process step. The WHC recommendation provides the needed temporary storage in the form of a Staging and Storage Facility.

3. National Environmental Policy Act Requirements

The DOE Programmatic EIS for Spent Nuclear Fuel Management (DOE 1994) was issued for public comment in June 1994. That EIS sets forth alternatives which address management of all DOE spent nuclear fuel including K Basins fuel. It will be difficult to proceed with a Hanford technical strategy, that prejudices or eliminates alternatives in the Programmatic EIS. Removal of the fuel and sludge from the K Basins could be constrained by the Record of Decision (ROD) for this and the related site-specific NEPA actions. The Programmatic EIS is also vulnerable to continued litigation and other delays which could delay early resolution of the K Basins safety and environmental concerns. The WHC recommendation proposes a phased NEPA strategy which minimizes this vulnerability.

4. Regulatory Uncertainty

DOE has provided draft guidance that new facilities needed for processing and storage of Hanford spent nuclear fuel must meet the intent of NRC regulations. This guidance will add additional burdens, since NRC regulations have not been previously applied to dry storage or processing of fuels similar to K Basins fuel. Development of a licensing requirement equivalency basis for dry storage should be relatively straight forward. However, the basis for processing is likely more complex and could require considerable characterization and process development to support a safety basis. This issue threatens Stabilization Facility schedules and indicates a need to

uncouple removal of fuel and sludge from the basins from startup of the Stabilization Facility.

5. Cost and Annual Budget Requirements

An overriding issue is the need to keep costs within an acceptable range, and to manage the technical strategy to preclude unduly large budget needs for any given fiscal year. Efforts were made to minimize concurrent construction projects and operation of multiple facilities for the WHC recommendation.

As a result of the above considerations, the Recommended Path Forward was compiled from the best portions of the set of alternatives, and was organized with a NEPA and regulatory overlay which minimized impacts of all of the above issues.

3.0 RECOMMENDED PATH FORWARD

3.1 OVERVIEW

The Recommended Path Forward utilizes the fuel containerization, drying, passivation, and vault dry storage concept developed by the ITA team. Construction of the proposed vault storage facility is accelerated to accommodate staging of wet packed fuel and sludge while the more complex Stabilization Facility is constructed and brought to a fully operable state. The vault storage facility also serves the 40-year dry interim storage function as fuel and sludge overpacks (multi-canister overpacks) are cycled through the Stabilization Facility for drying and passivation and returned to the storage vault.

The recommendation combines technical, NEPA, and regulatory strategies to accomplish two compelling goals:

1. Rapid removal of fuel and sludge from the K Basins and relocation away from the Columbia River, and

2. Placement of the fuel in safe, economic, and environmentally sound dry storage until the ultimate final disposition of the fuel is determined.

Each goal is to be in compliance with current DOE requirements and the intent of pertinent NRC requirements as well as applicable state and local requirements. The resulting strategy removes fuel and sludge from the K Basins by the year 2000 at a cost (through the year 2012) of approximately $1,150 million (unescalated) including operation and deactivation of Project facilities (including the K Basins).

The framework for the recommendation is a workable NEPA overlay which requires division of the Recommended Path Forward into two phases: the expedited response phase and the interim storage phase. The goal of the expedited response phase is to move the fuel and sludge into a new facility for temporary storage away from the Columbia River as soon as possible. This phase, which would be evaluated as the preferred alternative in an interim action EIS, rapidly improves protection of the public, the environment, and Hanford workers. The interim storage phase is structured to implement the ROD for a Hanford Site Spent Nuclear Fuel Management EIS which is compatible with the Programmatic EIS ROD. It is recommended that the Hanford Site Spent Nuclear Fuel Management EIS set forth several alternatives including drying, passivation, and storage of fuel as proposed by the ITA team. Foreign processing (SAIC 1994), as evaluated in Volume II, offers no schedule advantage for expedited removal of fuel and sludge from the basins. However, if supported by policy and the Programmatic EIS, it remains viable as an option in the interim storage phase. Other alternatives described by the Programmatic EIS are also retained.

The key elements of the Recommended Path Forward are shown in Figure 3-1 and are described below.

Expedited Response Phase

The expedited response phase would be evaluated as the preferred alternative in an interim action EIS. Fuel and sludge would be transferred from the K Basins to a newly constructed Staging and Storage Facility away from the Columbia River. The interim action EIS is justified by the urgent need to remove fuel and sludge from the K Basins. The preferred alternative is compatible with the Programmatic EIS in that all options being evaluated in the Programmatic EIS for management of spent nuclear fuel remain viable. Existing and modified facilities would be managed in accordance with DOE Orders. The new Staging and Storage Facility would be constructed and operated consistent with NRC technical requirements.

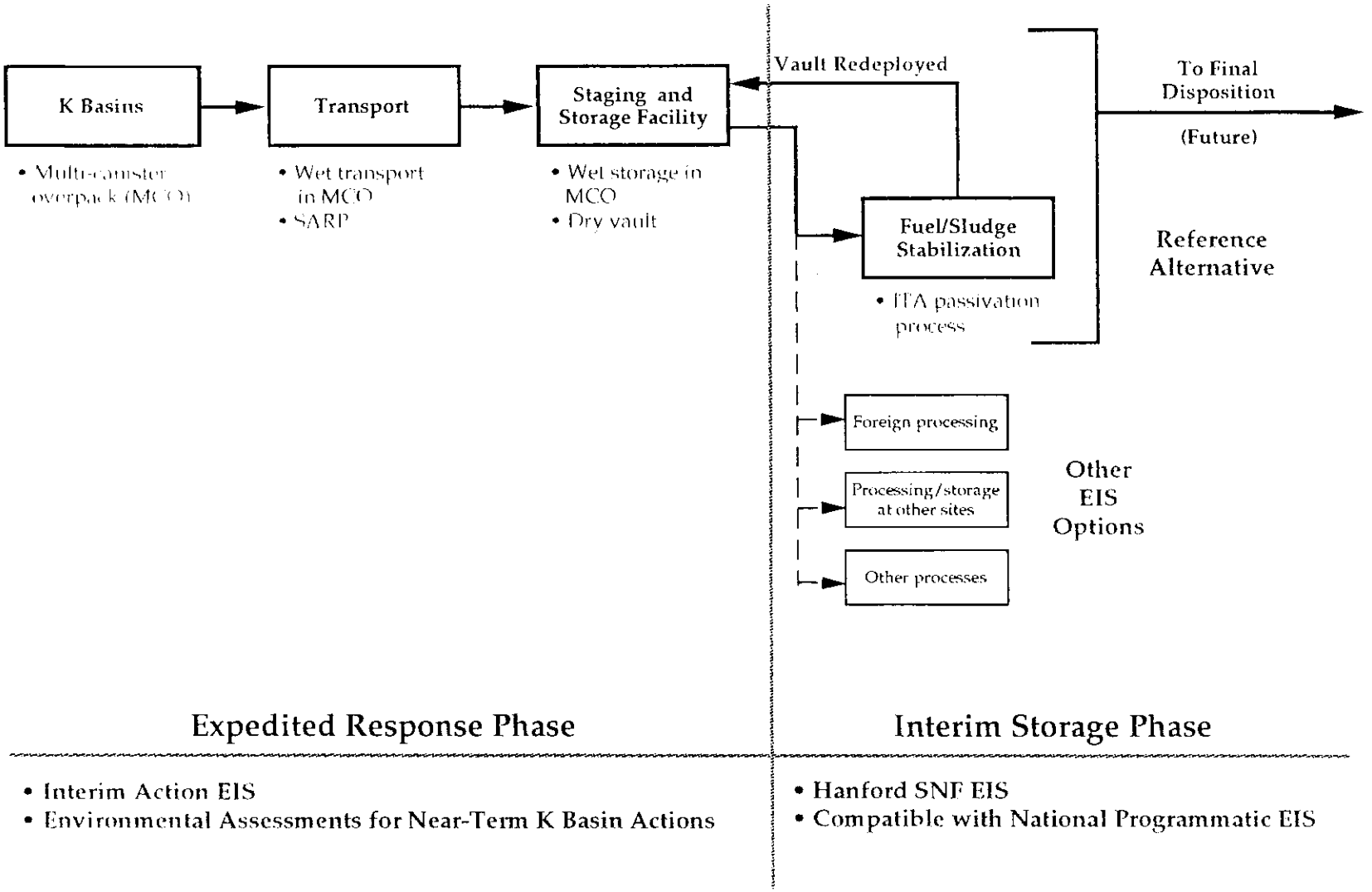
In the expedited response phase, fuel and sludge in K-East and K-West basins would be packaged in large multi-canister overpacks (MCO) described in the ITA team report (ITA 1994). Modifications would be constructed at the K Basins to enable minimum fuel and sludge handling to load the MCO. The MCOs are to be designed to store fuel and sludge in a wet or dry condition and would enable direct monitoring of fuel, sludge, and surrounding liquid and gas spaces during the temporary wet storage stage. A line item project would be proposed to construct a shielded vault Staging and Storage Facility to receive, store, and monitor the MCOs. Upon receipt from K Basins, the MCOs would contain wet-packed fuel and sludge and would be stored until staged into the Stabilization Facility. Design criteria for the Staging and Storage Facility would consider other Hanford spent nuclear fuel in development of functions and requirements. The MCOs would be held in the Staging and Storage Facility until the fuel stabilization (drying and passivation) process is available.

Interim Storage Phase

The second phase develops and constructs a fuel Stabilization Facility, based on the process developed by the ITA team (ITA 1994). The fuel and sludge are dried and passivated in the MCO and recycled to the vault storage facility to be stored for up to 40 years. This phase is dependent on a completed ROD for the DOE Programmatic EIS and would be evaluated as the reference alternative in a Hanford Spent Nuclear Fuel Management EIS. New facilities constructed during the second phase would be designed to the intent of NRC technical requirements.

During the second phase, MCOs would be transferred from the Staging and Storage Facility to the newly constructed fuel Stabilization Facility which would be co-located with the Staging and Storage Facility. Here, the fuel and unseparated sludge are dried and passivated to reduce the potential hazards associated with dry storage of the metal fuel. The size (annual throughput) of the Stabilization Facility would be balanced against operations costs to optimize plant size and processing duration since processing is not on the critical path to K Basins deactivation. This would likely reduce costs from those currently estimated. Development of design criteria for the Stabilization Facility will consider other Hanford spent nuclear fuel in development of functions and requirements. The Staging and Storage Facility would be redeployed for use as an interim storage facility until final disposition capability is available. The overpack (MCO) originally used for transport from the K Basins would also be reused for processing and dry interim storage of the fuel.

Figure 3-1
N-Reactor Fuel
Recommended Path Forward for K Basins



3.2 FACILITIES

The Recommended Path Forward does not propose a specific location for the newly constructed facilities. During the engineering studies, several facility options were evaluated including:

Newly Constructed Facilities - New construction would be located at an unspecified site within the 200 Area. Although capital costs could be somewhat greater than modifying existing facilities, this alternative is most compatible with centralization of future waste operations in the 200 Areas.

400 Area Fuels and Materials Examination Facility (FMEF) - Addition of a storage structure adjacent to the FMEF makes use of existing hardened shipping/receiving capabilities and security systems. This option is most attractive when existing hot cells in the FMEF are outfitted to perform the drying and passivation process. The FMEF is not located in the 200 Area and is therefore at a disadvantage.

Existing 200 Area Canyon Facility - PUREX was studied for potential as a storage facility. It was found to be very costly considering the extent of upgrades needed to achieve DOE Order compliance and the need to conduct construction in substantially radioactive zones.

Other Facilities - Other facilities, including WPPSS spray ponds, other canyon facilities, and an existing grout vault were studied and found unsuitable.

Site selection for implementation of the Recommended Path Forward would be initiated immediately and would comply with DOE-RL 4320.2C, "Site Selection."

3.3 CONCEPTUAL DESCRIPTION OF FUNCTIONAL ELEMENTS

The major functional elements associated with implementing the Recommended Path Forward are described in the following sections. Final design features of each of the functional elements will be optimized and selected during the design process. Systems engineering, value engineering, and detailed safety analysis will all influence final designs and assure safety and cost effectiveness.

Packaging Fuel and Sludge

- MCOs will be designed to hold wet canisters of fuel and sludge during transport and staging as well as stabilized fuel and sludge during dry interim storage. Design must be coordinated with that of the Staging and Storage Facility to assure that appropriate monitoring and maintenance capability is provided. The MCO will also have to be compatible with the Stabilization Facility, transport system, and dry interim storage requirements. One concept under consideration is to use a single container design but have replaceable lids that would be specifically designed for each phase of the operation.

- Fuel canisters would be loaded into MCOs which are capable of holding nominally ten canisters each. Sludge and water contained

within a canister will stay in the canister and will be separated and processed at the Stabilization Facility as necessary.

- Sludge on the floor of K-East Basin will be accumulated and packaged in containers that are compatible with the MCOs, assuming that collected sludge is to be processed and stored as fuel. Other paths for sludge are necessary if bulk sludge is classified as non-fuel or waste.

Transportation of MCOs

- MCOs will be transferred from the K Basins to the Staging and Storage Facility in a rail cask. It is assumed that the casks will be a standard available design which will require minimal, if any, modification to make them compatible with K Basins operations. The MCO and Staging and Storage Facility will be designed to be compatible with the rail cask.

- Nuclear safety requirements will be satisfied with a Safety Analysis Report for Packaging (SARP) as required by DOE-RL 5480.1, Chapter III, "Safety Requirements for the Packaging of Fissile and Other Radioactive Materials." Depending on the location of the Staging and Storage Facility, the cask may not be required to cross public highways. If policy changes or if the location of the facility on the Hanford Site requires that the rail cask cross public highways, additional U.S. Department of Transportation (DOT) certification may be required.

Staging and Storage Facility

- The Staging and Storage Facility will be designed so it can safely and cost effectively store fuel and sludge in either a wet or dry configuration.

- Unique design considerations for wet package staging include: (1) developing necessary venting capabilities to accommodate radiolytic gas generation; (2) providing the ability to selectively handle and correct an MCO that was exhibiting abnormal conditions such as leakage; and (3) water and gas blanket monitoring and treatment as necessary to maintain safety.

- The Staging and Storage Facility will be designed to allow transition from wet fuel storage to dry storage. The facility will be optimized during the definitive design process to assure the safest and most cost-effective configuration. Conceptual options that may be considered include:

  - Wet storage conditions would be contained entirely within the MCO with the outside of the MCO remaining dry. Monitoring of internal water levels and temperature would be required. MCOs containing dried passivated fuel would be returned to the facility after processing for interim storage with no changes to the facility except possible removal of monitoring equipment.

- A modular storage vault where modules could initially provide storage for the MCOs submerged under water. As modules are emptied of MCOs for processing, water is removed and the modules are converted for dry storage.

Stabilization Facility

- Fuel stabilization is achieved based on the process described in the ITA report (ITA 1994).
- The MCOs could be transferred to the Stabilization Facility using a cask designed for intra-facility transfer of MCOs. If possible, the same cask used for original transport of the MCOs from K Basins will be utilized.
- MCOs are received in the fuel Stabilization Facility and transferred into a shielded process enclosure. Fuel canisters may need to be removed from the MCO if contained sludge needs to be separated and accumulated for separate treatment or disposal. This requirement will be driven by process needs and/or the ultimate classification of sludge as a waste or as fuel. Sealed K-West canisters and closed bottomed K-East canisters would need to be opened and provisions for water removal applied.
- Fuel canisters are then returned to the MCO if necessary. The MCO is transferred to the process enclosure and connected to a gas supply and off-gas treatment system. The MCO is exposed to a programmed heating and purging sequence to first dry the fuel and then to provide a controlled oxygen introduction to passivate fuel surfaces.
- The MCO is finally cooled, sealed, loaded into the intra-facility transfer cask, and returned to the Staging and Storage Facility for dry interim storage. Contaminated water and sludge are removed during processing and dispositioned as consistent with K Basins bulk water and sludge.

Other K Basins Operations

- Water in the basins will be treated as necessary and disposed of as either a liquid effluent or a low-level liquid waste consistent with current DOE requirements.
- Debris removal from K Basins will be managed as described in the current baseline. Debris is defined as any material in the basins that is not fuel, sludge, or water. It will be accumulated, packaged, and disposed of as low-level solid waste or recycled.
- Other K Basins operations activities (such as temporary storage of fuel and sludge until they are removed, upgrades to safety, conduct of operations, and configuration management, and systems engineering activities to establish and maintain integrated cost, schedule, and technical baselines) will continue as described in the current baseline.

3.4 COST AND SCHEDULE

Cost and schedule estimates provided with this recommendation were developed in conjunction with the engineering studies summarized in Volumes II and III and were modified as appropriate when incorporated into the Recommended Path Forward. These estimates are preconceptual in nature and must be further developed and validated during the initial stages of implementation.

Figure 3-2 presents a summary schedule for implementation of the Recommended Path Forward. It assumes aggressive design, construction, and startup durations for facilities, and minimum feasible duration for transfer of fuel and sludge from K Basins. While startup of the Stabilization Facility is shown as early as reasonably attainable, the actual processing period is extended to four years instead of the aggressive two-year duration analyzed for the alternatives in Volume II. This extension anticipates further cost savings by reduction of the Stabilization Facility size since K Basins can be deactivated without fully completed dry processing of the fuel. The actual processing duration will be calculated to optimize costs during the design phase. The Recommended Path Forward completes fuel and sludge removal from the K Basins by November 2000 and completes conversion to dry storage by April 2006.

Table 3-1 presents the costs for construction, operation, and deactivation of the K Basins and proposed facilities through the year 2012. Decommissioning costs are also included for the Stabilization Facility. Contingencies and basis for estimation of various elements of the estimate are included in Volumes II and III. Total estimated cost is $1,150 million in constant fiscal year (FY) 1995 dollars. This estimate includes $277 million for operation of the K Basins and $180 million for deactivation of K Basins and decommissioning of the Stabilization Facility.

Fiscal year budget requirements through 2012 are presented in Figure 3-3 and Table 3-1.

3.5 NEPA STRATEGY

DOE currently is preparing a Programmatic EIS for spent nuclear fuel (DOE 1994) to determine the appropriate management of spent nuclear fuel throughout the DOE Complex. DOE may not take any actions which limit the reasonable alternatives for spent nuclear fuel management unless the action is independently justified, accompanied by an EIS, and will not prejudice the ultimate decision on the program (Title 40 Code of Federal Regulations, Part 1506.1). Therefore, actions to construct facilities and move fuel from K Basins must not compromise the Programmatic EIS. At the same time, waiting for the Programmatic EIS ROD exposes the removal of fuel from the basins to any delays in completion of that ROD. Such delays are likely when considering previous Programmatic EIS experience within the DOE.

Figure 3-2
K Basin Fuel Removal, Processing, and Storage Major Activity Schedule

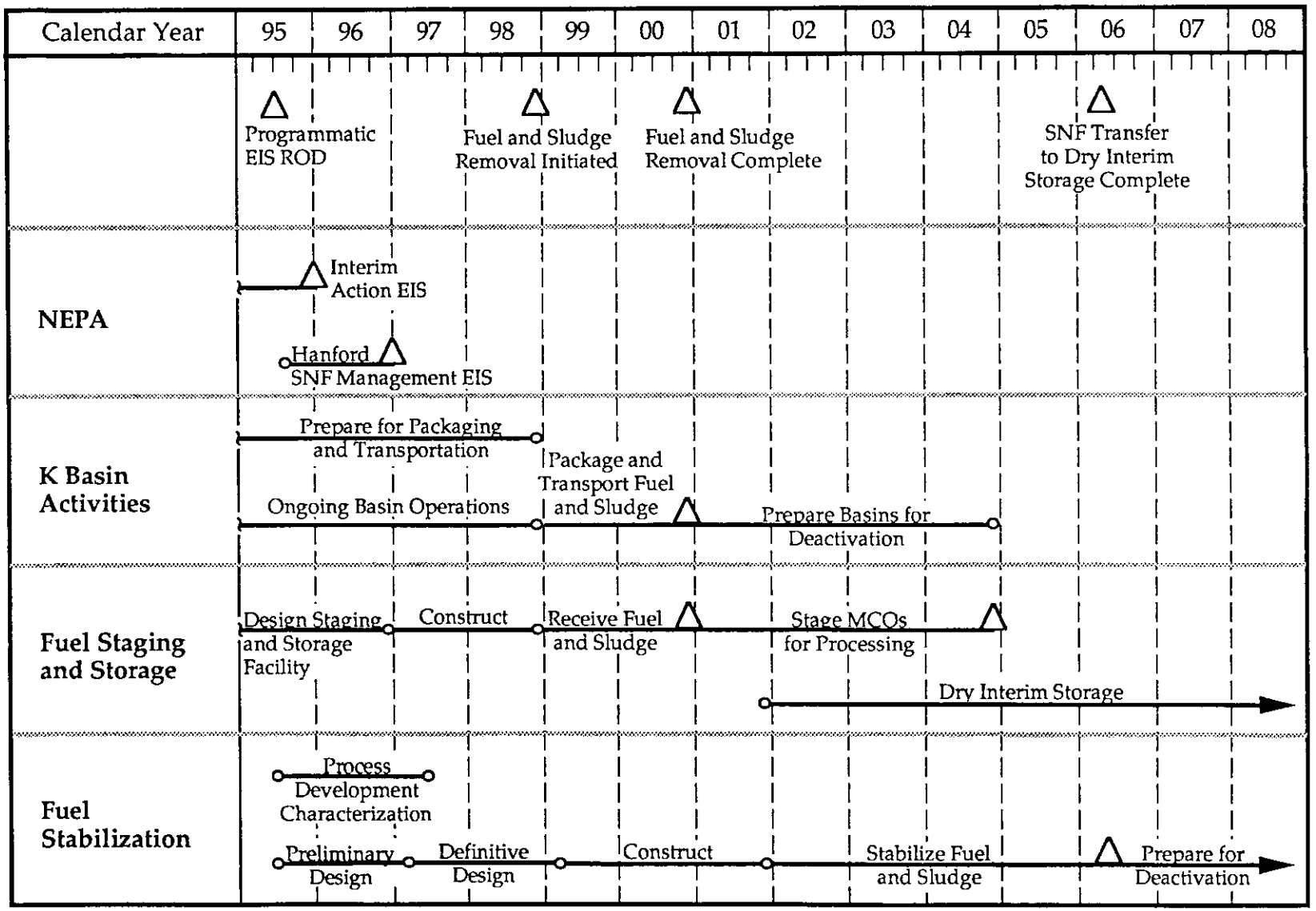


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Table 3-1
K Basin Fuel Removal, Processing, and Storage
Budget Profile

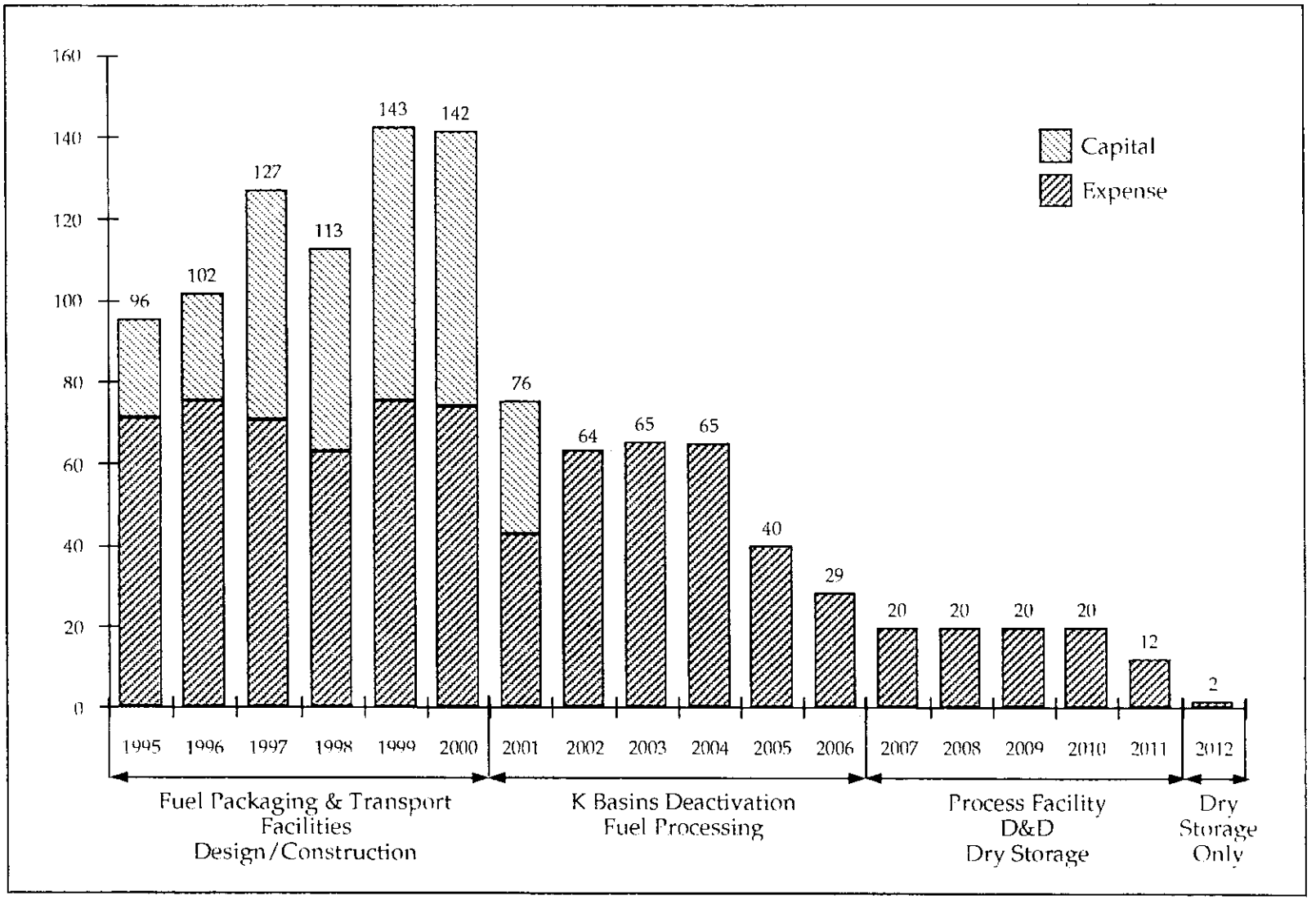
Costs shown in constant FY 1995 dollars (millions)

	Totals	1995*	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
K Basin Operations	**277.2**	**57.8**	**44.4**	**42.0**	**42.0**	**42.0**	**42.0**	**7.0**											
Capital	12.9	12.9																	
Expense	264.3	44.9	44.4	42.0	42.0	42.0	42.0	7.0											
K Basin Activities	**140.5**	**18.2**	**26.3**	**14.6**	**13.5**	**37.4**	**23.5**	**4.5**	**2.3**	**0.2**									
Capital	89.4	10.7	18.8	6.1	8.3	29.3	16.2												
Expense	51.1	7.5	7.5	8.5	5.2	8.1	7.3	4.5	2.3	0.2									
Transportation	**20.8**	**0.0**	**1.0**	**2.4**	**6.8**	**4.8**	**5.0**	**0.8**											
Capital	10.0		1.0	2.1	6.4	0.5													
Expense	10.8			0.3	0.4	4.3	5.0	0.8											
Fuel Stabilization	**248.9**	**4.5**	**12.2**	**12.5**	**8.2**	**38.5**	**51.7**	**49.0**	**17.5**	**15.3**	**15.3**	**15.3**	**8.9**						
Capital	133.2			4.3	7.3	37.6	51.3	32.7											
Expense	115.7	4.5	12.2	8.2	0.9	0.9	0.4	16.3	17.5	15.3	15.3	15.3	8.9						
Interim Storage	**159.7**	**3.0**	**7.3**	**45.4**	**31.8**	**9.5**	**9.0**	**3.8**	**8.0**	**9.0**	**9.0**	**9.0**	**5.9**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Capital	80.0	1.1	6.4	44.5	28.0														
Expense	79.7	1.9	0.9	0.9	3.8	9.5	9.0	3.8	8.0	9.0	9.0	9.0	5.9	1.5	1.5	1.5	1.5	1.5	1.5
D&D	**180.0**								**25.0**	**30.0**	**30.0**	**5.0**	**7.5**	**18.0**	**18.0**	**18.0**	**18.0**	**10.5**	
Capital	0.0																		
Expense	180.0								25.0	30.0	30.0	5.0	7.5	18.0	18.0	18.0	18.0	10.5	
Reg Intgr/Public Involvmt	**38.4**	**3.5**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**1.9**						
Capital	0.0																		
Expense	38.4	3.5	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	1.9						
Sys Eng/Proj Mgmt	**85.9**	**8.7**	**7.2**	**7.2**	**7.2**	**7.3**	**7.2**	**7.2**	**7.4**	**7.4**	**7.4**	**7.4**	**4.3**						
Capital	0.0																		
Expense	85.9	8.7	7.2	7.2	7.2	7.3	7.2	7.2	7.4	7.4	7.4	7.4	4.3						
Total	**1151.4**	**95.7**	**101.7**	**127.4**	**112.8**	**142.8**	**141.7**	**75.6**	**63.5**	**65.2**	**65.0**	**40.0**	**28.5**	**19.5**	**19.5**	**19.5**	**19.5**	**12.0**	**1.5**
Capital	325.5	24.7	26.2	57.0	50.0	67.4	67.5	32.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Expense	825.9	71.0	75.5	70.4	62.8	75.4	74.2	42.9	63.5	65.2	65.0	40.0	28.5	19.5	19.5	19.5	19.5	12.0	1.5

*Costs in FY 1995 are adjusted to include the entire fiscal year (10/1/94 to 9/30/95).

Volume II costs assume start date of 11/1/94. Total Recommended Path Forward costs from Volume II are $1,145 million.

Figure 3-3
K Basin Fuel Removal, Processing, and Storage
Fiscal Year Cost Profile
(Dollars in Millions)



The DOE NEPA compliance strategy to support expedited fuel removal relies on allowable interim actions prior to completion of the programmatic Spent Nuclear Fuel EIS and subsequent Hanford site Spent Nuclear Fuel Management EIS. Interim action environmental assessments would be needed for some near-term activities, such as characterization of fuel currently in the K Basins, fabrication or procurement and use of overpacks in K Basins. DOE should announce and begin preparation of an interim action EIS for expedited fuel removal immediately. This EIS would review the expedited fuel removal from the K Basins to the Staging and Storage Facility. A high priority must be assigned to the EIS in order to reach a ROD in 12-18 months. Because of the immediate need to expedite fuel removal DOE must also allow the definitive design of the Staging and Storage Facility to begin before reaching a ROD. Specific NEPA activities relative to the Recommended Path Forward are delineated in Section 4.2 of this report.

These interim actions are allowable in that they are independently justified by the need to expeditiously remove the fuel from K Basins. Any alternative for interim storage of the fuel would be supported by the operation of the Staging and Storage Facility. Future decisions pertaining to stabilization and dry storage of the fuel to implement the programmatic decision for interim storage would be reviewed by a future Hanford Site Spent Nuclear Fuel Management EIS which will be consistent with the completed Programmatic EIS ROD.

3.6 REGULATORY STRATEGY

WHC is legally and contractually committed to conduct activities, including design, construction, and operation of facilities, in accordance with the DOE Directives and Rulemaking system.

In addition, DOE is currently considering guidance which would subject the new facilities necessary for processing and/or storage of spent nuclear fuel to compliance with the intent of NRC regulations and requirements including specified national codes and standards. This guidance does not, however, commit to subject those facilities to actual NRC review and licensing.

Implementation of an NRC licensing requirement equivalency approach for new facilities would have little or no impact on existing or modified facilities. Therefore, fuel and sludge packaging and transport would fall entirely within the purview of the DOE Directives and Rulemaking system. In those areas where new facilities are to be constructed (i.e., the Staging and Storage Facility, and the Stabilization Facility), the equivalency approach would be utilized. Adoption of compliance standards similar to those enforced by the NRC contribute to the consistency of future requirements for stabilization and interim storage of DOE spent nuclear fuel.

WHC will identify NRC licensing requirements equivalency from the outset of the Recommended Path Forward. WHC will document the comparison between NRC and DOE requirements and will identify areas where no NRC requirements exist i.e, metal or other fuel types. For new facilities, if a DOE requirement exists, but no NRC regulation has been drafted, WHC will recommend updates to the DOE requirement as necessary and implement it. If no requirement has been

drafted by either agency, WHC will recommend areas in which DOE could issue appropriate guidance.

To facilitate this effort, it is recommended that a team of DOE-HQ, DOE-RL, and Project regulatory personnel be assembled to review initial implementation of the licensing requirements equivalency approach. This "Regulatory Team" would identify potential concerns regarding differences between DOE and NRC regulations to determine where the absence of any regulation necessitates the drafting of new requirements, and to provide guidance and direction during these transitional licensing phases.

3.7 AFFECTED TRIBES, REGULATOR, AND STAKEHOLDER INVOLVEMENT AND EVALUATION PROCESS

The Project will continue its proactive approach in the affected tribes and public involvement arenas. The strategy is consistent with past Project actions. There will be an ongoing dialogue with the affected tribes, regulators, and other stakeholders. Formal and informal input received to date from both affected tribes and public sources was incorporated as part of the Multi-Attribute Decision Analysis during the alternative evaluation. As DOE proceeds with its decision-making activities, affected tribes and stakeholders will be consulted as appropriate.

The Project will continue to meet with affected tribes, regulators, the Hanford Advisory Board, the news media, and any other interested parties on topics associated with Project activities. Meetings, tours, briefings, letters, and news conferences will be utilized to keep the public informed.

Affected tribes and public involvement will continue to play a key role in Project activities each time there is a key decision to be made. Such involvement in the NEPA process is mandated by law for decision making and the Project intends to aggressively pursue affected tribes and public involvement in support of any new decisions to be made.

Affected tribes and public involvement within the Project will continue to support specific goals within the areas of public participation, media relations, tribal government relations, other governmental relations, community relations, and employee relations.

3.8 ACQUISITION STRATEGY

The overall acquisition strategy for elements of the Recommended Path Forward is to maximize application of commercial technology and services and to minimize in-house engineering and construction. While relatively large design, fabrication, and construction contracts are anticipated, the projects and systems have been defined in a way which successfully accommodates NEPA, expedited schedules, and interfaces with existing facilities. The proposed acquisition strategy is based on WHC serving as the integrating contractor with the design, fabrication and construction being out-sourced to qualified suppliers as summarized below.

Facilities - Separate line item projects would be requested for the Staging and Storage Facility and Stabilization Facility consistent with the proposed NEPA strategy. The Staging and Storage Facility would be constructed as a turnkey design-and-build procurement. Since vault storage is based on well established NRC-licensed concepts, it could be readily designed and constructed.

The Stabilization Facility, while not complex, is further from established NRC licensed concepts and dependent on fuel characterization and process development data. Additionally, sufficient process design information will be needed early on to define the interfaces with the containerization system and the Staging and Storage Facility and to guide the process development work. Thus, the recommended approach for the Stabilization Facility is to establish a separate Architect/Engineering (A/E) contract followed by a construction contract. These actions will be consistent with the ROD for the Hanford Spent Nuclear Fuel Management EIS. This also provides the facility-specific inputs needed to establish the approach for achieving "licensability" of the Stabilization Facility. A/E involvement during the characterization and process development phases will assure closure in attaining NRC design equivalencies.

Containerization and Transportation Systems - Acquisition of the MCOs and transport system would be accomplished through a series of contracts for design and fabrication of each system. Since these systems are critical to timely removal of fuel and sludge from the basins, multiple parallel design contracts may be placed to assure adequate designs are obtained rapidly. The parallel contracts would result in alternative designs which would be evaluated, with the best one selected for fabrication. The design contracts would be phased to permit cancellation at no penalty as soon as it is clear which design is best. The design contracts will include an optional phase for supervision of the fabricator and for permitting, testing, and qualification as required by DOE Orders.

Technology - Technology acquisition will be most important in developing and demonstrating the drying and passivation process for N Reactor fuel. Pacific Northwest Laboratories will lead the technology acquisition activity, making best use of existing national and international experience. Technology required to support process development will be acquired through hot cell tests using the 327 Building or other facilities as required.

3.9 EVALUATION OF PATH FORWARD

Evaluation of the various alternatives considered for mitigation of K Basins fuel and sludge was performed in four steps. Initial screening of alternatives against fundamental requirements was followed by evaluation of programmatic and environmental health and safety risks, and by multi-attribute decision analysis. Alternatives were modified if necessary to meet minimum requirements or to enhance performance. These evaluations are described in Volume II.

The Recommended Path Forward was developed using many aspects of the alternatives, but it is unique. Evaluation of the Recommended Path Forward is discussed below.

Objectives

The WHC Path Forward Evaluation process, discussed in Volume II, identified the fundamental objectives important to making a decision relative the Recommended Path Forward. The criteria associated with the objectives were then developed. The premise is that if the individual criteria are realized, then the objectives will be achieved.

The fundamental objectives relative to removing spent nuclear fuel from the Hanford K Basins and the necessary stabilization for suitable interim storage are:

1. **Minimize total costs.**

2. **Minimize public, worker and environmental health risks.**

3. **Minimize the schedule** in relation to the time for removal of fuel and sludge from the K Basins, the time for placement of fuel in interim storage, and the time for disposal of all other waste.

4. **Maximize affected tribes and stakeholder confidence** relative to the safe management of spent nuclear fuels and associated waste by minimizing its transport, maximizing its removal from near the Columbia River, and meet, or exceed, the Tri-Party Agreement 2002 target milestone.

5. **Maximize technical performance** by maximizing the stabilization of spent nuclear fuel, maximizing available technology transfer, minimizing generated waste, and maximizing the use of available, demonstrated technology.

6. **Maximize the likelihood of programmatic success** by considering uncertainties in costs, schedule, available technology, and important external constraints.

An evaluation of the above objectives and the relative importance of the associated attributes lead to the conclusion that the important stakeholder values could be succinctly summarized as:

> Remove the fuel and sludge from the K Basins, away from the Columbia River, with a high probability of meeting, or exceeding the 2002 Tri-Party Agreement target milestone; paying attention to worker health risk and total costs.

The following information describes how the Recommended Path Forward meets the above objectives and, specifically, the above affected tribes stakeholder values.

Evaluation of Recommended Path Forward Relative to Objectives

The Recommended Path Forward, as defined, focuses on:

- Separating the process of removing fuel and sludge from the K Basins from the operation of the Stabilization Facility.

- Simplifying the process of removing fuel and sludge from the K Basins.
- Providing a storage capability to act as a staging operation for the overpacked fuel containers as they are removed from the K Basins.
- Combining the staging and dry interim storage functions into one facility to reduce the necessity of constructing two facilities.
- Maintaining a flexible fuel stabilization process capability.

The Recommended Path Forward capitalized on important concepts identified for expeditiously removing fuel and sludge from the K Basins. The aggressive schedule date of the Recommended Path Forward for having the spent nuclear fuel removed from the K Basins is November 2000. The costs of the Recommended Path Forward are comparable to costs of other alternatives evaluated.

The schedule of the Recommended Path Forward minimizes the risks to the public and environment from continued operation of the K Basins. The total risk for the Recommended Path Forward is comparable to the risks of other alternatives. Public risks from the operation of removing fuel from the K Basins and the following stabilization process are within the goal of the DOE Nuclear Safety Policy (DOE 1991). Worker risks from construction operations are within the range of U. S. construction worker fatalities (NSC 1992).

The Recommended Path Forward was compared to the other four alternatives that were evaluated in Volume II and their results are summarized in Table 3-2. As expected, the Recommended Path Forward compares favorably relative to the other alternatives. The information provided in Table 3-2 demonstrates that the Recommended Path Forward satisfies the fundamental objectives, and thus, provides the recommended approach for achieving the Stakeholder values.

Programmatic Risks Associated with Recommended Path Forward

The goal of the programmatic risk evaluation is to identify those elements of a process that must be managed in order for the program objectives to be satisfied. For the Recommended Path Forward, a major objective is to remove fuel and sludge from the K Basins by November 2000. Therefore, the parameter distributions in the programmatic risk model associated with each task in the schedule were reviewed. The focus was to identify those tasks, which if effectively managed (i.e., have very tight distributions, or small standard deviations), would ensure meeting the aggressive schedule.

The tasks in the Recommended Path Forward schedule that were identified as critical are:

- Package and transport fuel to the Staging and Storage Facility,
- Timely construction of the Staging and Storage Facility, and
- Design and procurement of the transportation system.

Table 3-2
Path Forward Alternatives Comparison
Summary Results

Key Objectives	Recommended Path Forward	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1. Minimize Costs (millions)	$1,150	$1,192	$1,223	$1,086	$1,897 - $3,397
2. Minimize Health Risks Evaluated public, worker, and environmental risks	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
3. Minimize Schedule					
Removal of spent nuclear fuel from K Basins	11/2000	11/2003	11/2000	06/2003	04/2004
Placement of spent nuclear in storage	04/2006	11/2003	03/2003	06/2003	NA**
Total Multi-Attribute Utility Score*	788	253	610	545	NA***

* The Multi-Attribute Utility Score reflects the sum of the weighted and ranked criteria scores (See Volume II, Section 5.3).
** Stabilized fuel returned after processing (date undefined).
***Alternative 4 not scored because of fundamental differences in approach.

By successfully managing these tasks, the fuel and sludge can be removed from the K Basins by November 2000, as desired, with 90% confidence that the fuel and sludge can be removed from the K Basins by June 2001. The summary results of the programmatic risk evaluation for the aggressive schedule case are given in Table 3-3.

TABLE 3-3 SUMMARY OF PROGRAMMATIC RISK EVALUATION RESULTS

Key Objectives	Recommended Path Forward Analysis Results
1. Minimize Costs	
Mean	$1,150*
90% Confidence Value	$1,245
2. Minimize Schedule	
Removal of spent nuclear fuel from K Basins	
Mean	11/2000
90% Confidence Value	06/2001
3. Placement of spent nuclear fuel in Storage	
Mean	04/2006
90% Confidence Value	10/2007

*Volume II total for Recommended Path Forward is $1,145 million. FY 1995 costs were annualized in Volume I to include the part of FY 1995 that was not included in Volume II analysis.

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4.0 ACTIONS TO IMPLEMENT RECOMMENDED PATH FORWARD

The Recommended Path Forward represents an aggressive schedule and a workable method of achieving key Project objectives. Many activities on the recommended schedule are accelerated over normal business practices in order to remove spent nuclear fuel from the K Basins as quickly as possible. As a result, some actions associated with achieving key elements of the recommendation will have to be expedited.

Critical actions, especially those that must occur or be initiated in fiscal year 1995 are described in this document. Rough order-of-magnitude estimates indicate fiscal year 1995 funding requirements of approximately $96 million. A comprehensive review to develop budget-quality cost and schedule estimates will be completed three months after authorization to proceed. Change control actions will also be performed to the Fiscal Year 1995 Multi-Year Program Plan to provide scope and budget consistent with the Recommended Path Forward.

The actions occur in three major areas:

- acquisition of new project facilities and equipment including process development,
- implementation of the NEPA regulatory, and public involvement strategies, and
- providing incremental funding over the approved budget.

WHC recognizes that there are some actions required to implement this Recommended Path Forward that are solely within the purview of the Department of Energy. Recommended DOE actions are identified along with WHC actions.

4.1 ACQUISITION OF NEW FACILITIES AND SYSTEMS

Many actions will be required in FY 1995 to assure that the new project facilities will be available when they are needed. Chief among these are those actions required to initiate design and construction of the Staging and Storage Facility. Expedited validation is required to initiate definitive design by August 1995 and start of construction by November 1996. This activity will also include engineering development work associated with development of the multi-canister overpacks and the transportation system.

The major actions associated with acquisition of staging and storage capability are:

- functional design criteria and conceptual design development for the Staging and Storage Facility, multi-canister overpacks, and transportation systems;
- validation quality cost and schedule estimate development;
- flowsheet and design basis development
- preliminary safety evaluation of the proposed systems;

- formal siting evaluation;
- interface identification with other site systems (i.e., liquid and solid waste systems);
- permitting plan and quality assurance plan development;
- Architect/Engineer selection.

WHC would manage the aforementioned actions in concert with other Hanford contractors and offsite vendors as needed to maximize application of commercial technology and services and minimize in-house engineering and construction.

WHC recommends that DOE take the necessary action to expedite approval of the required line item funding to support timely design and construction of the Staging and Storage Facility, and acquisition of the multi-canister overpacks and the transportation system.

Preparation of the validation package for the fuel Stabilization Facility would also be initiated in FY 1995. Acquisition of this facility would occur under an expedited line item budget cycle and would be proposed as a FY 1997 line item. Process development and preliminary design for the fuel Stabilization Facility (both expense funded) would be initiated in FY 1995 to develop necessary interface requirements for the Staging and Storage Facility design.

4.2 IMPLEMENTATION OF NEPA, REGULATORY, AND AFFECTED TRIBES AND PUBLIC INVOLVEMENT

NEPA Actions

The Recommended Path Forward was designed around a workable NEPA strategy, utilizing an interim action EIS to fulfill NEPA requirements for the expedited response phase. This requires an aggressive NEPA schedule, including immediate initiation of the interim action EIS and several Environmental Assessments. Approval to proceed with definitive design of the Staging and Storage Facility and the multi-canister overpacks prior to the completion of the record of decision will also be required. Expeditious handling of the entire NEPA process will be required to meet the recommended schedule.

WHC recognizes that most of these actions, such as approval to proceed with definitive design, publishing the Notice of Intent, and hiring a contractor to prepare the EIS are solely within the purview of DOE. WHC would provide support as necessary and appropriate, including preparation of a draft Action Description Memorandum and Notice of Intent if requested.

Regulatory Actions

WHC recommends several actions take place in support of the Regulatory Recommended Path Forward. Initially, the specific requirements of the applicable DOE directives will be verified to assure timely and efficient actions.

In addition, WHC recommends a regulatory team of DOE-HQ, DOE-RL, and Project personnel be assembled to review initial implementation of the licensing requirements equivalency approach. This team would identify differences between DOE and NRC regulations, determine where the absence of any regulation necessitates the drafting of new requirements, and provides guidance and direction during these transitional licensing phases. The team would develop an implementation plan encompassing each of the above activities and outline provisions for addressing the currently evolving regulations. The implementation plan would also identify regulatory strategies for expeditious implementation of the Recommended Path Forward.

Affected tribes and Public Involvement Actions

Follow-up meetings will be held with the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, the U.S. Environmental Protection Agency, State of Washington Department of Ecology, and the Hanford Advisory Board as DOE proceeds with their decision-making activities in the Recommended Path Forward. Additional meetings with the Oregon Waste Board and the Oregon Department of Energy are being discussed.

Additional affected tribes and public involvement activities will be conducted to support the NEPA strategy. This will include the activities required by NEPA regulations and additional formal and informal activities needed to assure appropriate affected tribes and stakeholder involvement.

A Stakeholder Communication and Participation Strategy for the Project is being prepared which will identify more specific affected tribes and public involvement activities.

4.3 PROVIDING INCREMENTAL FUNDING

It is estimated that approximately $16 million over the current approved FY 1995 budget request of $80 million would be required to support the Recommended Path Forward. WHC will develop budget-quality estimates and detailed scope and schedules for DOE review and approval to accompany the Project Management Plan three months after authorization to proceed. WHC will make every effort to use innovative engineering and contracting strategies to reduce costs.

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5.0 REFERENCES

DNFSB, 1994, "Recommendation 94-1 to the Secretary of Energy," May 26, 1994.

DOE, 1991, U.S. Department of Energy, Secretary of Energy Notice, "Nuclear Safety Policy," SEN-25-91.

DOE, 1993, "DOE Spent Fuel Working Group Assessment (Vulnerabilities)," November 1993.

DOE, 1994, "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Draft Environmental Impact Statement," DOE/EIS-0203-D, June 1994.

ITA, 1994, "Dry Storage of N Reactor Fuel - Volumes I and II," Independent Technical Assessment Team, September 1994.

NSC, 1992, "Accident Facts - 1992 Edition," National Safety Council, Chicago, Illinois, 1992.

SAIC, 1994, "BNFL Concept Review - Regulatory and Policy Issues," prepared for Westinghouse Hanford Company by Science Applications International Corporation, September 7, 1994.